APPENDIX F
Geotechnical Feasibility Evaluation

AGI

Aragón Geotechnical, Inc.

GEOTECHNICAL FEASIBILITY EVALUATION
WCA WALNUT CREEK HABITAT & OPEN SPACE PROJECT
SAN DIMAS
LOS ANGELES COUNTY, CALIFORNIA

FOR
AHBE LANDSCAPE ARCHITECTS
8729 WASHINGTON BOULEVARD
CULVER CITY, CALIFORNIA 90232

PROJECT NO. 4061-SF
JUNE 8, 2011

AGI
Aragón Geotechnical, Inc.
Consultants In The Earth & Material Sciences
CALIFORNIA • NEVADA • MEXICO

June 8, 2011
Project No. 4061-SF

AHBE Landscape Architects
8729 Washington Boulevard
Culver City, California 90232

Subject: Geotechnical Feasibility Evaluation
WCA Walnut Creek Habitat & Open Space Project
San Dimas, Los Angeles County, California

Attention: Mr. Evan Mather, RLA, ASLA

Gentlemen:

In accordance with our proposed scope and your authorization, Aragón Geotechnical Inc. (AGI) has completed preliminary soils engineering and geological assessments for the above-referenced 60.9-acre project site. The attached report presents findings, opinions, and recommendations developed as a result of limited field reconnaissance observations, technical report reviews, historical research, and engineering and geological analyses.

The site area exhibits two quite different sets of geomorphic and geologic characteristics. The eastern half of the project is hilly, brushy, steeply sloped, and crossed by several deep ravines. Geological materials in the eastern half consist of volcanic rocks of the Glendora Volcanics series, mantled with usually thin horizons of topsoil and colluvium. Major rock types consist of cemented or welded andesite breccia and some interpreted andesite flows. Units are believed to dip steeply south, and form part of the north limb of a major synclinal fold.

The western half of the project includes a gently inclined and low-relief older alluvial fan surface. Older alluvium appears to comprise granular mixtures of gravel, sand, and silt with low clay content. Layering or bedding is not obvious. Near-surface alluvium has been disturbed by past agricultural practices, weed abatement, and burrowing fauna. The western half also includes smaller areas of steep ravine and canyon slopes peripheral to Walnut Creek. Close to the creek in the northwestern corner of the site, slope areas may be underlain by the La Vida Member of the Puente Formation, a landslide-prone sedimentary unit composed mostly of bedded siltstone.

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Geological hazards at the project site consist of highly localized areas of known landslides, and some potential for small mudslides or debris flows in eastern ravines. There are multiple site areas included in official zones of required investigation for liquefaction and landslide hazard potential. Occupancy structures proposed for zoned areas would need detailed future geotechnical studies in accordance with Los Angeles County ordinances. However, preliminary findings suggest liquefaction risks should not exist in the site. Landslide hazard risks should be low outside of very steeply sloped areas (inclinations ~35 degrees or greater). No constraints to park site development appear to exist in the most-useful flat areas of the site. The probabilities of the site being affected by surface fault rupture, seiching, induced flooding, tsunami, and excessive settlement appear to range from extremely low to zero.

The evaluation findings support our preliminary opinion that the site should be suitable for public uses from a geotechnical viewpoint. Existing historical buildings at the site appear to be sited on stable ground. Geotechnical conditions for their rehabilitation, if elected, should be favorable. There are limited areas of undocumented fill requiring removal and placement as compacted engineered fill if structural improvements are proposed in some undeveloped areas. Almost any native-soil area can be expected to require treatments of loose topsoil zones for buildings, paving, or flatwork. All of the on-site soil materials are preliminarily considered suitable for reuse in structural fills, provided debris and vegetation are excluded.

Future subsurface geotechnical studies are recommended to develop specifications for engineered grading, foundation or wall design, construction materials, and final assignments of loads for seismic retrofit of historical buildings. AGI welcomes requests for site programming reviews, advice on feasibility for specific program elements, and ultimately a scope for a design-phase investigation.

Thank you very much for this opportunity to be of service. Please do not hesitate to call if you should have any questions.

Very truly yours,
Aragón Geotechnical, Inc.

Mark G. Doerschlag, CEG 1752
Engineering Geologist

C. Fernando Aragón, M.S.
Project Engineer, RCE 72277

MGD/CFA:mma

Distribution: (4) Addressee

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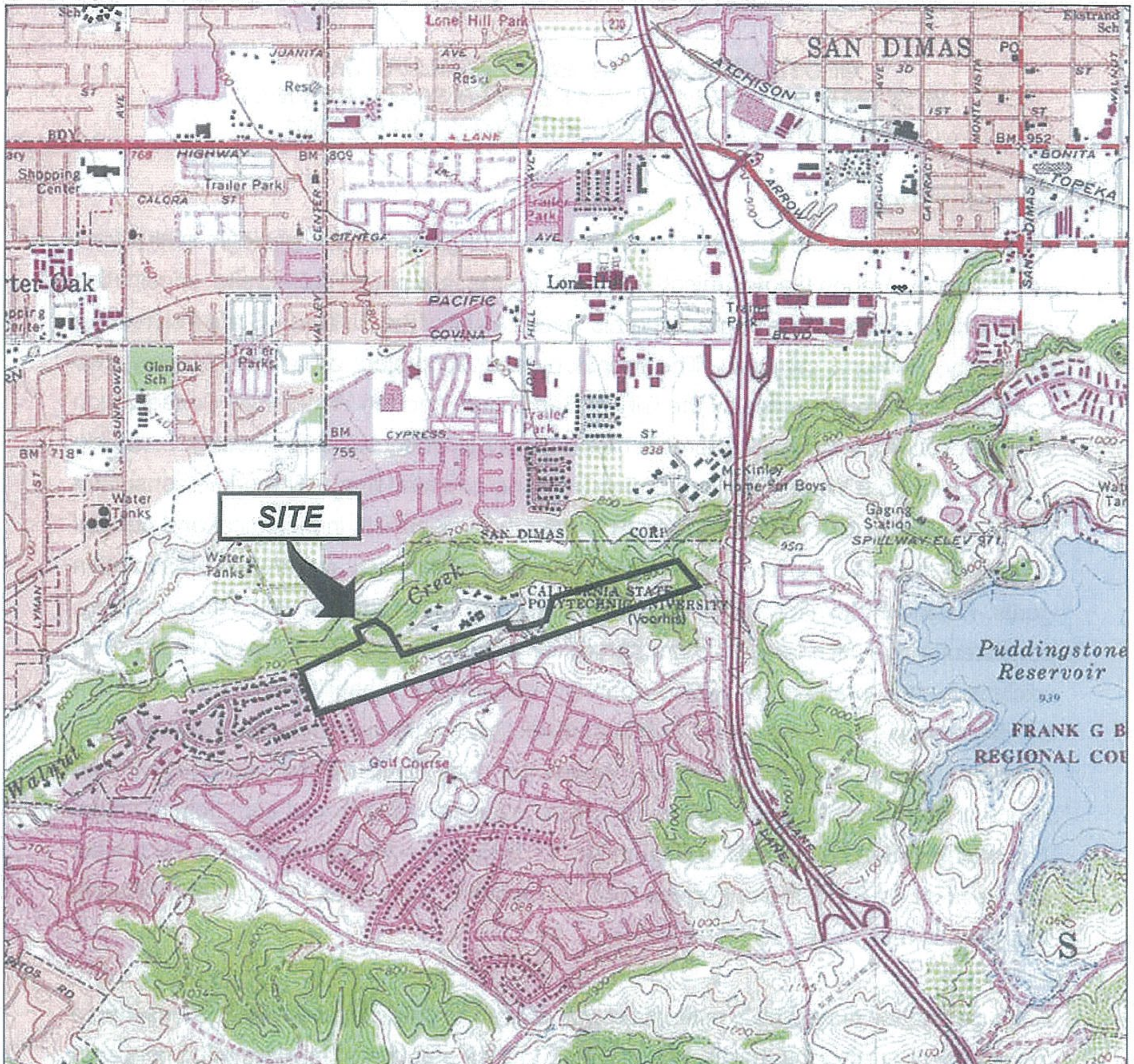
GEOTECHNICAL FEASIBILITY EVALUATION
WCA WALNUT CREEK HABITAT & OPEN SPACE PROJECT
SAN DIMAS, LOS ANGELES COUNTY, CALIFORNIA

1.0 INTRODUCTION

This report presents the results of preliminary soils engineering and geologic evaluations conducted by Aragón Geotechnical, Inc. (AGI) for the referenced project site, constituting a subdivided portion of the former "Voorhis" satellite unit of the California State Polytechnic University, Pomona campus. The irregularly shaped project area encompasses two contiguous holdings owned by the City of San Dimas and the Watershed Conservation Authority (WCA), totaling 60.9 acres in the northern half of Section 9 (projected), Township 1 South, Range 9 West (San Bernardino Baseline and Meridian). The prime consultant AHBE, in conjunction with input from AGI and other specialists in biological and cultural resources, has been tasked with devising potential public uses and habitat preservation goals. Relatively "low-impact" park-type infrastructure improvements would be most likely, consistent with similar uses on other parcels owned by the WCA. However, we have not excluded considerations for new occupancy structures if rehabilitation of older on-site buildings proves to be infeasible. Political jurisdiction is entirely within unincorporated Los Angeles County, although site development will very likely require coordination and approval of multiple agencies given the project's joint ownership and high habitat value. The attached Site Location Map (Figure No. 1) depicts the general location of the project with respect to local thoroughfares and surrounding land uses on a 1:24,000-scale topographic base map.

AGI's geotechnical feasibility evaluation was geared to detecting any obvious unsuitable development areas, and helping guide AHBE in their creation of programming concepts that respect local geological conditions. The primary objectives of the evaluation included qualitative assessments of geologic hazard potentials, geomorphic characterization of the site, descriptions of probable engineering properties of local soils and bedrock, and derivation of *preliminary* engineering opinions and recommendations for future subsurface investigations. Accordingly, AGI's scope included reconnaissance of the site and surrounding land parcels, aerial photo interpretation, technical literature research, and historical research to help confirm the nature and degree of grading alterations to the site. Design-level subsurface explorations, soil sampling, laboratory testing, environmental research, or chemical testing of air, soil, or groundwater found in the project area were beyond the scope of this limited geotechnical feasibility study.



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References: U.S. Geological Survey 7½-Minute Series Topographic Map, San Dimas Quadrangle (1981).

AGI Aragón Geotechnical, Inc.	SITE LOCATION MAP		
	WCA WALNUT CREEK HABITAT & OPEN-SPACE PROJECT, SAN DIMAS, CA.		
	PROJECT NO. 4061-SF	DATE: 6/10/11	**FIGURE 1**

2.0 PROPOSED CONSTRUCTION

Site programming goals include creation of three master-plan concepts, to be based on the WCA's stewardship goals, compatibility with surrounding land uses, and compatibility with site geotechnical, geologic, and hydrologic conditions. The Walnut Creek project could speculatively include improvements such as hard-surfaced paths, picnic sites, and lightweight non-occupancy structures such as interpretive kiosks or restrooms. Vehicle access might be developed through neighboring private property, or via a connection to city streets through Loma Vista Park. New pavements would probably be required. Public trail connections to the L.A. County Michael D. Antonovich (MDA) multi-use trail or the Walnut Creek stream bed would be reasonable considerations during site programming.

Several historical buildings in various states of disrepair are located in the study area. We understand that the WCA is potentially interested in rehabilitation of buildings where feasible and cost-effective. Bringing old structures "up to code" may at a minimum involve remediation for lead-based architectural coatings, electrical and plumbing upgrades, and structural enhancements for seismic mitigation. Some discussions concerning ground conditions affecting earthquake safety enhancements are included later in this report.

The conjoined parcels already include underground wet and dry utility lines (water, sewer, gas) and remnants of overhead electrical circuits. The condition of buried utilities is not known. We are also not aware of whether wastewater mains are connected to municipal sewer service. Historically, the Voorhis property included a private wastewater disposal facility that today would be located on an off-site parcel to the north. Judgments about soil infiltration characteristics and general feasibility of either municipal sewerage connections or an on-site wastewater treatment system (OWTS) were considered over the course of this feasibility study.

AGI believes significant grading is very unlikely for park improvements. Remedial grading for existing undocumented fills could be required in certain localities, depending mostly on the selected programming concept. We would predict some degree of site stripping or "removals" to correct near-surface compressible soils conditions wherever structural improvements are proposed. We would generally assume that structural grading (other than potential trail development) would be limited to already-disturbed terrain in the central and western portions of the study area.

3.0 FIELD INVESTIGATION

Site reconnaissance for this limited study was conducted by AGI's senior Engineering Geologist on May 16, 2011. The WCA property does not currently have regular public access. A short segment of the MDA multi-use trail briefly crosses into (unsigned) WCA property limits at the eastern end of the project. This area was field-checked beginning at the trail access point along San Dimas Avenue. Rugged and very brushy terrain prevented cross-country traverses in the eastern third of the WCA parcel within the permitted one-day excursion time. However, impediments were much less severe elsewhere, and with rare exception almost all terrain within the project perimeter in the central and western site areas could be examined on the ground.

A site topographic map obtained from AHBE was used to plot our geological reconnaissance data. The map featured land surface elevations at one-foot contour intervals and the locations of cultural features such as roads and buildings. The base map had originally been prepared in September 2008. Few changes seem to have occurred since then. The modified topographic map is included as a pair of 100'-scale Geotechnical Map sheets (Plate Nos. 1 and 2) located at the back of this report.

4.0 SITE GEOTECHNICAL CONDITIONS

4.1 Previous Site Uses

AGI's scope included limited historical research to ascertain changes to surficial conditions through time, and address known or possible geotechnical impacts to future construction. Ground-level and aerial oblique photographs were reviewed in the "Voorhis" archives of the Special Collections Room, Cal Poly University Library. Vertical stereo-pair aerial photographs were interpreted for evidence of past structures and land use, as well as for geological assessments of active faulting potential, land instability, and geomorphic history.

The 60.9-acre project area is part of an original 157-acre holding of Charles B. Voorhis, a successful and philanthropic General Motors executive. In 1928, Mr. Voorhis began construction of a collection of Spanish-style buildings, a concrete reservoir, roads, and other improvements on mostly flat lands south of Walnut Creek that would become the Voorhis School for Boys. Findings indicated that four tile-roofed and stucco buildings in the project area date from this era. Photographs showed all of the original school buildings were built with little to no grading or ground improvement, and foundations bearing within native soils. Most of the WCA study area was retained in a more-or-less natural condition that was typified by very widely scattered oak trees and grasslands. In 1938, the entire school property was donated to the California Polytechnic State College (San Luis Obispo) for a southern California campus. It remained an operating unit of the State university system until 1957, several years beyond the dedication of the new 813-acre Cal Poly Pomona campus in 1950. The university added several buildings in the Voorhis property that were probably used for agricultural sciences studies. Irrigated orchards were laid out on flat mesa-like terrain in the western half of the WCA property and along terraces carved out of slopes. However, the study area is not believed to have ever been used for university-related or commercial poultry, stock-raising, equestrian, or dairying operations.

The WCA has indicated the property was subsequently sold to the Pacific Coast Bible College. The school property was ultimately subdivided into two parcels by a recorded instrument for Tract No. 10345. The northern parcel encompassed about two-thirds of the acreage plus most original Voorhis school structures and numerous more-modern improvements. It is presently owned and operated by the Tzu Chi Foundation for educational programs and international humanitarian relief efforts. The boundary between the Tzu Chi site and the WCA's Walnut Creek project has not been demarcated in the field by continuous fences or gates. As noted before, some existing utility services may originate from, or terminate within, the Tzu Chi parcel.

4.2 Surface Conditions

Site access can reportedly be gained through the Tzu Chi property, or from the south through a gated and locked connection to Calle Bandera street and the adjacent Woodwalk residential community. We understand the latter will remain limited to emergency ingress and egress only. Loma Vista Park, a developed City of San Dimas facility, is contiguous with the project area along the southern property line but separated by a fence (Plate No. 1). Undeveloped areas at the east end of the project can be entered from the MDA trail.

Terrain in the western third of the project area features a low-relief mesa-like surface bordered to the north by moderately steep north-facing slopes. A small tributary ravine to Walnut Creek has a somewhat unusual east-west trend in this area, and separates the WCA project site from a correlative mesa surface underlying the Tzu Chi buildings. The western ravine has slope gradients ranging from about 40 to 100 percent. South-facing slopes are steeper than north-facing slopes. At the time of our late-spring reconnaissance, the low-relief areas sported dense growths of mostly non-native grasses and forbs, but few trees. Ground surfaces were loose and disturbed by burrowing fauna, frequent man-made pits and trenches, and probable past weed abatement practices. Archived photos showed that all flatter parts of the WCA project area had been State university citrus orchards at one time. Intact concrete irrigation standpipes were located in the field. We also observed step-like graded terraces on some north-facing ravine slopes, and confirmed from pictures that sloped areas were used for avocado orchards. All cultivated trees have been removed. The ravine areas have become densely wooded with oak trees and some introduced species. Understory vegetation was commonly composed of grasses, vinca, wild blackberry, and clumps of poison oak.

Buildings are clustered in the middle third of the project site. This is the only area believed to have had localized cut-and-fill grading, based on historical images and AGI field checks. The area features several paved narrow streets, driveways, and parking lots that follow parts of the western ravine "headwaters". Part of the ravine immediately south of the Tzu Chi headquarters building comprises fill. The filled and paved area terminates against a retaining wall at the west end. Map data indicate the filled area is mostly within WCA property limits. The humanitarian organization has placed a newer metal storage building on the ravine fill. Two level areas flanking the gated access road to Calle Bandera also appear to be composed of fill up to 8 or 10 feet deep (Plate No. 1). None of the fills are known to have been built with engineering observation and compaction testing. Accordingly, all site fill is categorized as undocumented fill.

Older site structures consist of simple wood-frame and board sheds, more-substantial wood-frame and stucco single-story buildings in the predominant Spanish style, and one two-story building interpreted to have been the Voorhis school maintenance facility. The latter structure has reinforced concrete columns and a hillside retaining wall supporting a second-story concrete floor. The second story walls and roof are likely conventional frame construction. Drive-in vehicle service bays are apparent from mechanic's pits in the ground floor. The Cal Poly Special Collections Room supplied photos indicating a motor fuel pump was present in front of the garages in the 1930's. We have speculations an underground storage tank was removed from the pump location, but this was not verified for this limited geotechnical study.

The eastern third of the WCA site features precipitous slopes and deeply incised ravines. Maximum local relief of about 235 feet occurs in this area. Dense perennial woody shrubs, trees, and poison oak hamper accessibility. Higher ridges tend to have less vegetation, though, and offer good views of the eastern San Gabriel Valley.

4.3 Hydrology

The San Dimas area enjoys a typical Southern California Mediterranean climate regime typified by cool, wet winters and warm dry summers. Almost all rain falls from November through April. Weather records for the San Dimas Fire Station indicate average annual precipitation between 1906 and 2009 was 18.5 inches. The wettest month of the year is January with an average rainfall of about 4.3 inches in the project area (Western Regional Climate Center, 2010).

Site contour maps show that all surface runoff from the WCA project site eventually empties into Walnut Creek. Believed to currently flow year-round from a mix of natural and anthropic runoff sources, Walnut Creek drains more than 58 square miles upgradient of the project. The watershed encompasses the northern San Jose Hills and Puddingstone areas, the suburban community of San Dimas plus parts of Covina, La Verne, and Glendora, and several smaller tributary canyons in the San Gabriel Mountains. Regulated flows exit from an earth and rockfill dam for Puddingstone Reservoir east of the site (Figure No. 1). The reservoir and surrounding Frank G. Bonelli Regional Park are Los Angeles County facilities maintained for flood control and recreation benefits. Elevation 971 is the reservoir spillway elevation, although the lake is contractually maintained at about Elevation 942 to protect surrounding recreational uses. To our knowledge, it has spilled only twice in the last

40 years. The reservoir is quite likely a significant recharge source for downstream reaches of Walnut Creek and deep permanent aquifers in the area.

Only a tiny sliver of the WCA project site touches the creek bed in the eastern part of the study area. Developed or low-relief parts of the site in the central and western parts of the project are generally at least 130 feet higher than the incised canyon bottom. Cobble and boulder stream sediments atop bedrock occur near the northeastern project limits, while sand and gravel bottom conditions appear to predominate farther downstream. At the time of our field survey, the channel had vigorous surface water flows.

The WCA project area *receives* off-site runoff from (1) Several very small tributary watersheds southeast of the site; and (2) An indeterminate portion of the Tzu Chi complex. The tributary watersheds drain natural, vegetated mountain slopes spanning an estimated 22 acres in aggregate. Anthropic contributions to runoff in these natural watersheds are close to nil. Runoff from the Tzu Chi property would originate from a mix of natural slopes, landscaped areas, roofs, and paved surfaces. The school complex pre-dates requirements for water quality management plans or implementation of source control or treatment control practices. We did not observe during our reconnaissance any features suggestive of active water quality management.

A key finding is that the project area receives virtually no discharges from the Woodwalk residential tract or Loma Vista Park. Street and lot runoff from the adjacent properties is directed via side streets to Avenida Loma Vista. AGI checked for and did not encounter pipes, culverts, or swales entering the project area from the tract.

The WCA project area *discharges* runoff to the north and northwest. Principal lines of concentrated flow would be four steep-sided natural ravines in the eastern part of the site, and one large ravine in the central and western areas. Infiltration capacity is limited in the eastern area due to slopes and shallow bedrock. Some surface runoff could thus be expected from most typical winter storm events. The flatter parts of the site are judged to have much greater infiltration capacity. Surface runoff would be less common and would generally move by sheetflow. All tributary ravines to Walnut Creek appear to support only transient, seasonal water flows. One small 60- to 80-foot-long zone of seepage or surface flow was seen in the upper western ravine during AGI's reconnaissance; however, the location suggested a possible man-made origin from the Tzu Chi property.

5.0 ENGINEERING GEOLOGIC ANALYSES

5.1 Regional Geologic Setting

San Dimas lies close to the northern margin of the Peninsular Ranges Physiographic Province, one of 11 provinces recognized in California. The physiographic provinces are topographic-geologic groupings of convenience based primarily on landforms, characteristic lithologies, and late Cenozoic structural and geomorphic history. The Peninsular Ranges encompass southwestern California west of the Imperial-Coachella Valley trough and south of the elevated terranes of the San Gabriel and San Bernardino Mountains. Most of the province lies outside of California, where it comprises much of the Baja California Peninsula. The province is characterized by youthful, steeply sloped, northwest-trending elongated ranges and intervening valleys. Approaching the northern edge of the province, however, several anomalously flat and low basins stretch from the San Gorgonio Pass region to western Los Angeles as a result of fault junctures and tectonic interaction with the adjacent Transverse Ranges.

Structurally, the Peninsular Ranges province in California is composed of a number of relatively stable crustal blocks bounded by active faults of the San Andreas transform system. Although some folding, minor faulting, and random seismic activity can be found within the blocks, intense structural deformation and large earthquakes are mostly limited to the block margins. Exceptions are most notable approaching the Los Angeles Basin, where compressive stress gives rise to increasing degrees of vertical offset along the transform faults and a change in deformation style that includes young folds and active thrust ramps. The easternmost San Gabriel Valley is a fairly poorly understood zone of structural complexity where tectonic uplift has dominated (San Jose Hills, parts of San Dimas, La Verne, and Glendora), creating the significant drainage divide between the upper Santa Ana River basin and the San Gabriel River watershed.

The Peninsular Ranges structural blocks are dominated by the presence of intrusive granitic rock types similar to those in the Sierra Nevada, although the province additionally contains a diverse array of metamorphic, sedimentary, and extrusive volcanic rocks. Sedimentary units become far more common toward the Los Angeles Basin. Thick sequences of marine and non-marine clastic sedimentary rocks of Mesozoic and Tertiary age, ranging from claystones to conglomerate, occur in the San Jose Hills and along the San Gabriel Mountains foothills. The sedimentary stack is interrupted by volcanic flows, breccia units, and some intercalated tuffs and detrital sediments that are very prominent in the northeastern San Jose Hills. Peninsular Ranges crystalline basement materials comprising various types of granite are located as close as Ganesha Park (L.A. County Fairplex area) and the northern Chino Hills.

5.2 Local Geologic Conditions

Olmsted (1950) prepared the first detailed geologic map of the San Jose Hills, although the map ended west of the study area close to what is now Grand Avenue. His proposition that the San Jose Hills were essentially a west-plunging asymmetric anticline has been borne out by field studies of Cal Poly Pomona students and professors (e.g., Baltzer & Jessey, 2001) and workers from the California Geological Survey during preparation of hazard maps of the San Dimas quadrangle (e.g., Perez et al., 1998). More-recent work by Tan (2000) strongly hints the San Jose Hills anticline northeast of the Interstate 10 freeway is paired with a west-plunging syncline. The fold axis is centered more or less coincident with Via Verde (a local street) and Puddingstone Reservoir. AGI observations included convincing evidence for steep south dips in project site volcanic units, representative of the north limb of the "San Jose Hills syncline". One tiny exposure of in-place sedimentary bedrock close to the northwestern project limits exhibited thin beds with very steep north (overturned) dips.

The oldest site bedrock unit is correlated to the middle Miocene-age Glendora Volcanics (unit Tga of Tan, 2000). Volcanic rock underlies most of the central and eastern thirds of the project site. There are a few bold rock outcroppings, but most mapped areas comprise fairly smooth convex slopes with a moderate soil cover. Major rock types include dark purplish gray andesite lava breccia and some interpreted flows. The volcanic unit is hard and strong where not intensely fractured or highly weathered.

Although almost entirely concealed by thick colluvial and slopewash soils, we have provisionally identified sedimentary bedrock near the northwestern project limits as the La Vida Member of the Puente Formation (Tpl on Plate No. 1). The predominant La Vida lithologies in the San Jose Hills are laminated to platy siltstone with interbedded pebbly sandstone and local limestone beds. The unit is ascribed a deep-water marine origin. Fish scales are reportedly distinctive to the formation but were not readily apparent at the WCA site. The La Vida Member is widely recognized for landslide susceptibility.

The flatter areas of the WCA site, the Tzu Chi complex, and the developed suburban areas of western San Dimas are parts of a broad, older alluvial fan surface (unit Qofs of Tan, 2000). Walnut Creek and its subsidiary drainages have dissected the surface in excess of 150 feet deep. Structural interpretations hint the alluvial unit is deepest at the western end of the project, and pinches out toward the center of the site. The on-site older alluvium appears to comprise silty and gravelly sand that was derived from both San Jose Hills rock types and San Gabriel Mountains crystalline basement. Pedogenic soil development in older alluvium at the site is notably weak. During the site evaluation, low clay content and minimal carbonate enrichment characterized Qofs deposits below the bioturbated, very silty topsoil horizons checked in scattered trench exposures or eroded gullies. Tan (2000) categorized the undivided older fan deposits as Pleistocene in age.

5.3 Groundwater

AGI reviewed supplied WCA documents, historical archives, and various agency databases to check for wells on the study site. None are known. We think the Voorhis School for Boys was once served by a well that would be located just west of a former concrete storage reservoir. It is not known if the hypothesized well is actually present, operative, or abandoned. The storage reservoir was empty on the day of our field visit. Specific data concerning depths to the static phreatic surface in the immediate area were not found.

It would be reasonable to conclude static groundwater depths beneath the site should be roughly coincident with the elevation of Walnut Creek. It is considered a line of recharge. It follows that minimum depths to groundwater in the project site probably vary from near zero next to the creek up to more than 200 feet in the highest-elevation areas. Map interpretations indicate groundwater would be stored in fractured bedrock, most likely Glendora Volcanics or deeper sandstones of the Topanga Formation. Deep alluvial aquifers are not interpreted for the site.

5.4 Erosion Potential

Qualitative judgments of erosion susceptibility were considered for typical site materials. Erodibility is a function of material type (soil vs. rock), silt and clay proportions, slope, organic content, degree of cover, and surficial disturbance. Highly erodible soils in a construction environment may produce unacceptable runoff water quality unless mitigation measures are considered.

- Low erosion potential: Natural and man-made bare-rock slopes in Glendora Volcanics, or Puente Formation strata in deep cuts (none on-site).
- Medium erosion potential: Undisturbed colluvium on volcanic or sedimentary bedrock, under natural vegetation cover and seasonal slopewash conditions.
- High erosion potential: Natural or disturbed older fan surfaces (Qofs), particularly if concentrated flow is present; disturbed colluvium in ravines; all soil horizons on volcanic unit Tga if site is subject to fire or vegetation cover is otherwise lost.

5.5 Geological Hazard Assessments

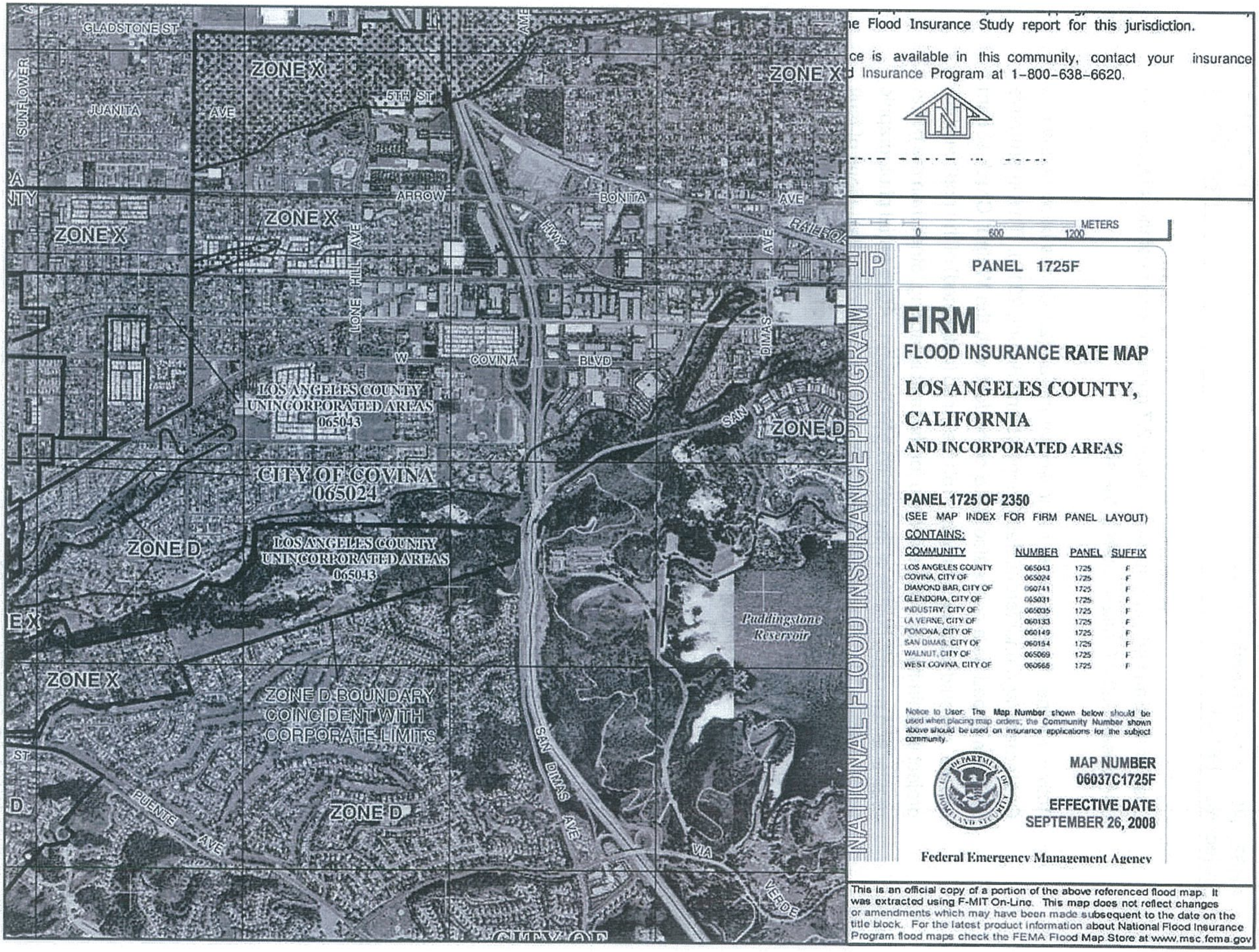
5.5.1 Regulatory Hazard Zones

Earthquake Fault Zones. Ground offset presents a primary or direct potential hazard to structures built across an active surface fault trace. Reviews of official maps delineating State of California Earthquake Fault Zones and Los Angeles County special hazard management zones indicated no portion of the WCA site is located within a zone of required investigation for active faulting. The closest *zoned* active regional fault traces are associated with the Cucamonga segment of the Sierra Madre fault zone near San Antonio Canyon, about 9.8 miles distant. Other presumed active faults that are *not zoned* but included in statewide risk assessment hazard models include other Sierra Madre Fault strands near the base of the San Gabriel Mountains about 2.7 miles due north of the site, and the San Jose Fault 2.0 miles south of the site.

Activity for the "Walnut Creek Fault" shown in Tan (2000) has been defined as Quaternary, age undifferentiated (Jennings and Bryant, 2010). This interpretive fault is mapped as a concealed trace coincident with the Walnut Creek stream course. It would approach to within 150 feet or so (estimated) of the northwestern project area limits. Surface evidence for the fault is lacking, other than the rather regular and arcuate course of the geomorphic canyon. AGI's aerial photographic interpretations did not suggest visible lineaments or other manifestations of fault topography indicative of active fault traces on or adjacent to the site. We judge the potential for surface fault rupture within the site from the Walnut Creek Fault or other better-defined faults to be extremely low.

Seismic Hazard Zones (Liquefaction & Landslide). Title 14 of the California Code of Regulations tasks the California Geological Survey with preparing State maps depicting zones of required investigation for the hazards of earthquake-induced liquefaction and landsliding. All of coastal Los Angeles County and Orange County have been mapped. The official San Dimas quadrangle map (California Department of Conservation, 1999) places multiple parts of the WCA project area in special studies zones for these hazards. The official map is small-scale (1:24,000) and does not have good fidelity with respect to local topography or later geological maps. The Geotechnical Maps, Plates 1 and 2 in this report, illustrate the State zones as closely as we could achieve with digital enlargement and overlays. It is important to understand the zones are for regulatory risk reduction, and do not automatically imply the presence of the hazard. They merely illustrate areas where combinations of factors (geology, groundwater, slope, and earthquake exposure) may be conducive to occurrence. Preliminary risk assessments for the study area are discussed further in Sections 5.5.4 and 5.5.5.

Flooding. The WCA Walnut Creek site is currently accorded a designation of flood zone X, or "not susceptible to flooding" (FEMA, 2008; Figure No. 2). Walnut Creek is not fully regulated at the site, as it does receive some urban flows from storm drains downstream of Puddingstone Reservoir, but is also included in zone



Flood Insurance Study report for this jurisdiction.
ce is available in this community, contact your insurance
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GLADSTONE ST
SUNFLOWER
JUANITA
AVE
ZONE X
5TH ST
ARROW
BONITA
AVE
LONE HILL AVE
HWY
RAILROAD
W
COVINA
BLVD
DIMAS
SAN
LOS ANGELES COUNTY UNINCORPORATED AREAS 065043
CITY OF COVINA 065024
ZONE D
Puddingstone Reservoir
ZONE D BOUNDARY COINCIDENT WITH CORPORATE LIMITS
PUENTE AVE
SAN DIMAS AVE
VIA VERDE
METERS
0 600 1200
NATIONAL FLOOD INSURANCE PROGRAM
PANEL 1725F
FIRM
FLOOD INSURANCE RATE MAP
LOS ANGELES COUNTY, CALIFORNIA
AND INCORPORATED AREAS
PANEL 1725 OF 2350
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)
CONTAINS:
COMMUNITY NUMBER PANEL SUFFIX
LOS ANGELES COUNTY 065043 1725 F
COVINA, CITY OF 065024 1725 F
DIAMOND BAR, CITY OF 060741 1725 F
GLENDORA, CITY OF 065031 1725 F
INDUSTRY, CITY OF 065035 1725 F
LA VERNE, CITY OF 060133 1725 F
POMONA, CITY OF 060149 1725 F
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EFFECTIVE DATE SEPTEMBER 26, 2008
Federal Emergency Management Agency
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FIGURE NO. 2

X. Some flood risks could be reasonably assumed for canyon bottom locations within a few feet of mean water elevations. However, considering the almost complete exclusion of Walnut Creek surface flows from the project area, favorable site topography, and the small sizes of watersheds upslope of the WCA project area, flood risks are considered to be insignificant.

5.5.2 Faulting and Regional Seismicity

The project is situated in region of active and potentially active faults, as is all of metropolitan Southern California. Active faults present several potential risks to structures and people. Besides ground rupture along fault traces, hazards associated with active faults include strong earthquake ground shaking, soil densification and liquefaction, mass wasting (landsliding), and induced flooding. Generally, the following four factors are the principal determinants of seismic risk at a given location:

- Distance to seismogenically capable faults.
- The maximum or "characteristic" magnitude earthquake for a capable fault.
- Seismic recurrence interval, in turn related to tectonic slip rates.
- Nature of earth materials underlying the site.

5.5.3 Strong Motion Potential

All Southern California construction is considered to be at high risk of experiencing strong ground motion during a structure's design life. The proximity of the large and complex Sierra Madre fault zone (Cucamonga segment) to the site defines this seismic source as the most critical source of potentially damaging ground motion at the site, according to Perez et al. (1998). However, the San Jose Fault, the Whittier Fault, and the San Andreas Fault should also be considered potentially significant sources of shaking at the site. Other regional faults are far less likely to pose risks as great as those posed by the listed faults, due to greater distances and/or longer recurrence intervals.

Sierra Madre Fault Zone: This fault zone and related extensions trend east-west from the western San Fernando Valley to an abrupt terminus near Devore in San Bernardino County. The fault zone's location is grossly defined by the base of the steep southern escarpment of the San Gabriel Mountains where the range borders the Los Angeles and Chino Basins. The zone comprises several arcuate bands of closely spaced, imbricate fault strands that generally dip to the north at about 45 degrees. One segment of the zone, the Cucamonga Fault, has a western end somewhat arbitrarily placed about 10 miles away; this segment is interpreted to have greater earthquake potential than most of the fault zone. The predominant sense of offset in the zone is reverse. Historic activity of the zone has included the 1971 San Fernando earthquake. Close to the site, however, the zone has been nearly quiescent in historic time except for uncommon microearthquakes.

San Jose Fault: The San Jose Fault constitutes the main structural boundary between the San Jose anticline and several additional synclinal and anticlinal folds to the south. The fault is known to extend from the La Verne area through the Cal Poly Pomona campus and then southwest toward La Puente where it dies out. The south-verging fold-and-thrust belt and geophysical data have been interpreted by Yeats (2000) to indicate the San Jose Fault is in fact a north-dipping reverse fault, partly blind to the west, that may merge at depth with other blind structures to form a single seismogenic source. Earthquakes in Upland in 1988 and 1990 originally ascribed to the San Jose Fault based on focal mechanisms more likely occurred on a different fault. Detailed trenching work at Cal Poly has supported the reverse-offset interpretation. Although not included in official Earthquake Fault Zones, the San Jose Fault is viewed as active and is included as a (strike-slip) seismic source in the 2003 California hazard model (Petersen et al., 1996; Cao, 2003), with subsequent incorporated into the 2008 national model.

Earthquake catalogs maintained by the Southern California Earthquake Center indicate dozens events of local magnitude M5.0 or greater have occurred within 100 kilometers of the site since instrumented recordings started in 1932. Notable historical earthquakes in Southern California over the last 19 years (Northridge, Landers, Hector Mine) were relatively distant. They produced estimated peak ground accelerations well under 0.10g in the San Dimas area.

Earthquake shaking hazards are quantified by deterministic calculation (specified source, specified magnitude, and a distance attenuation function), or probabilistic analysis (chance of exceedance considering all sources and all potential magnitudes for a specified exposure period). With certain special exceptions, today's engineering codes and practice generally utilize probabilistic hazard analysis. Prescribed parameter values calculated for the 2008 U.S national hazard model indicate the site has a 10 percent risk in 50 years of peak ground accelerations exceeding approximately 0.46g, and 2 percent chance in 50-year exposure period of exceeding 0.80g (U.S. Geological Survey, 2011a). The reported peak ground accelerations were linearly interpolated from 0.05-degree gridded data and include soil correction. Neither deterministic nor probabilistic acceleration values should be construed as exact predictions of site response. *Actual* shaking intensities from any seismic source may be substantially higher or lower than estimated for a given earthquake event, due to complex and unpredictable effects from variables such as:

- Near-source directivity of horizontal shaking components
- Rupture propagation direction, length, or mode (strike-slip, normal, reverse)
- Depth and consistency of unconsolidated sediments
- Topography
- Geologic structure underlying the site
- Seismic wave reflection, refraction, and interference (basin effects)

5.5.4 Liquefaction

Liquefaction is the transformation of a granular material from a solid state into a semi-fluid state as a consequence of increased pore-water pressure. Certain soil materials subjected to ground vibrations will tend to compact and decrease in volume. If the materials are saturated and drainage is unable to occur, the tendency to decrease in volume will result in an increase in pore-water pressure. If the pore-water pressure builds up to a point where it is equal to the overburden stress, the effective stress becomes zero, the soil loses strength, and it may become capable of flowing as a viscous fluid. Opportunity is highest for sites in seismic regions where groundwater is within a few feet of the ground surface. Soil susceptibility is highest for very loose sand or non-plastic silt. Soil susceptibility usually decreases with increasing depth, relative density, clay content, and geologic age of the deposit. Consolidated sedimentary strata and igneous bedrock are immune to liquefaction phenomena.

Our professional judgments would suggest that liquefaction risks are virtually nil in the site. This subjective assessment derives from proven presence of sedimentary and igneous bedrock in the on-site zoned areas shown on the Geotechnical Maps, and the interpreted lack of shallow groundwater in all mapped soil areas (unit Qofs). The Pleistocene age of the Qofs sediments would inhibit susceptibility even if unexpected perched water were present at depth, close to alluvial-bedrock contacts.

5.5.5 Landslide Hazards

Three landslides are shown on Plate No. 1 in the western part of the project area (map unit Qls). They were identified by contour interpretation and field checks. The smallest slide area occupies part of a minor drainage and may be characterized as a slumped and filled area within the older alluvial mesa deposits. Slightly to the north, two larger masses appear to be rooted in Puente Formation bedrock. Their occurrence may be ascribed to low material strength and possible unfavorable slope-parallel bedding orientations.

A large queried landslide (Qls?) is shown on Plate No. 2 in the eastern third of the WCA project area. Geomorphic clues to a possible slide would be the local east-west trends of ridges, saddles, and ravines. Tan (1988) mapped the outlined area on Plate No. 2 as part of the landslide inventory for the San Dimas quadrangle.

Later mapping including California Department of Conservation (1999) and Tan (2000) excluded the queried slide from known unstable areas. Cursory AGI field inspections indicated the "landslide" is composed of Glendora Volcanics andesite breccia. The main ridge is very likely an in-place, strike-parallel layer of particularly resistant material that lines up with similar resistant knobs farther to the west. The structural interpretation is consistent with steeply south-dipping horizons defining the north limb of a synclinal fold. We provisionally agree with the later references indicating the outlined area is not a slide, but have retained the (Qls?) designation to indicate further study is needed.

Other than the mapped landslides, obvious expressions of land instability were not found within the WCA project area, including the required investigation zones shown on the Geotechnical Maps. Very small or surficial unstable masses may not have been detected, though. Additionally, surficial soil creep would be expected on almost any steep slopes. Proper geotechnical engineering can mitigate very small slides or creep to levels of insignificance.

5.5.6 Debris Flow & Shallow Mass Wasting

Mobilization of shallow earth slumps where soil infiltration is impeded by shallow bedrock, or rapid erosional downcutting and ravine sidewall slumping can precipitate a debris flow. The slurry-like mixtures of soil and water may quickly entrain large rocks, trees, and other destructive objects. The hazard is particularly acute after wildfire, when peculiar hydrophobic effects disrupt normal soil matric suction and rainfall is not absorbed.

All ravine and canyon bottoms at the site have moderate to high risk from this hazard, in our opinion. Ravines traversing or draining volcanic bedrock areas will be more susceptible. Debris flows may originate off-site and pass through the project in the larger eastern ravines. Risks to people and infrastructure should remain minimal if they are not in ravine thalwegs. Historically developed parts of the site, and the flat western mesa areas, have essentially zero risk.

5.5.7 Induced Flooding

The WCA project site is not near tanks or located immediately next to surface impoundments that could result in flooding from tank rupture or seiche. The inland site has zero risk from tsunami. The already-developed portions of the site are also sufficiently elevated to preclude risks from earthquake-induced inundation due to loss of Puddingstone Dam. The dam is managed by the Los Angeles County Department of Public Works. Built in 1928, the facility comprises a 147-foot-high main dam and two saddle dams of engineered earthen embankment construction. It is continuously monitored by the County and the State's Division of Safety of Dams. Maximum rated capacity of the reservoir is 17,190 acre-feet (AF), but it is usually maintained at about 6,000 AF. The City of San Dimas General Plan safety element indicates reservoir loss would remain entirely within the confines of the geomorphic Walnut Creek canyon. Mitigation for earthquake-induced flooding potential should not be required.

5.5.8 Settlement

Bedrock areas (map units Tpl and Tga) are not susceptible to settlement. Based principally on the age of the materials, older fan alluvium (Qofs) should also have insignificant dynamic settlement potential. Subsurface testing should confirm these preliminary judgments at a later stage of the design timeline.

5.4.9 Expansive Soils

Clay-bearing soils can be capable of substantial changes in volume depending on water content. Soil expansion is easily capable of lifting and damaging pavements, slabs, and building foundations. In Southern California, swelling or expansive soils usually develop distinctive textures and obvious surface manifestations such as shrinkage cracks from seasonal moisture changes.

Cursory visual-manual soil classifications during AGI's reconnaissance did not find "clay" soil types. Site soils over volcanic bedrock tended to be sandy and low-cohesion. Older alluvium was granular to very silty, non-plastic, and free of notable shrinkage cracks. Site soil materials are preliminarily characterized as "low" to "very low" expansion potential pending engineering verification tests.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 General

Based on the limited data obtained to date, professional experience, and judgment, it is our opinion that the WCA project site should be suitable from a geological and geotechnical viewpoint for park uses. Virtually any location should be safe for simple hiking or multi-use trails where human presence is transient and not expected at times of higher risk (e.g., storms). Most site areas are also judged safe and adequate for utility improvements, park hardscape, roads or pavements, and new occupancy buildings. Exceptions are currently limited to known landslides (unit Qls), and the bottoms of larger ravines and canyons where flooding and debris flow hazards exist. The putative "landslide" (Qls?) in the eastern part of the project is also judged suitable for typical park improvements (it has high scenic value and would be an excellent viewpoint / shade ramada / picnic site), but is not definitively free of hazard for a building. Lastly, findings indicate the site's historical buildings are not at excess risk from earthquake fault lines, landsliding, liquefaction, flooding, debris flow, or subsidence. Decisions for their re-use may lie mostly with restoration costs.

Prescriptive mitigation for the hazard of strong ground motion is nominally provided by structural design adherence to local adopted building codes. Section 6.4 contains conservative (pre-investigation) short- and long-period spectral accelerations that may be useful for assessing structural requirements and costs for building rehabilitations.

The main unfavorable geotechnical or soils-related conditions include loose near-surface native soil horizons and unknown quality or uniformity of as-built fills. It is AGI's finding and conclusion that the existing fills and surficial soil horizons at the site should not be considered acceptable for support of structural fill, new foundations, and other prospective improvements in their current condition. The existing fills are not engineered fills. They may approach or exceed 10 feet in depth in certain areas. It should be acceptable to leave old fill in place if current non-structural uses are continued and/or only new softscape landscaping is proposed. The uppermost older alluvial materials and hillslope colluvium exhibit disturbance and have judged high compressibility.

If *occupancy buildings* are proposed for any colored zoned area depicted on the Geotechnical Maps, then special studies for the listed hazard are required. The hazard investigations should be performed in accordance with State of California guidelines in California Geological Survey Special Publication 117 (Department of Conservation, 2008) and the expected hazard potentials. We have already indicated we believe liquefaction hazard potentials are very low. Landslide hazard potential would need to be quantified by a combination of surface mapping, subsurface exploration, laboratory soils tests, and engineering calculations. We believe slope inclinations in landslide hazard zones would make structures infeasible. AGI recommends zero improvements or structures atop mapped landslides in the western half of the project.

6.2 Site Grading Information

The general guidelines presented below are supplied for designer and stakeholder information regarding expected geotechnical input during construction. These are not formal project construction specifications. These guidelines reflect the usual progress of engineered grading and quality control requirements in Los Angeles County. AGI would expect that all compacted engineered fills will be placed and compacted under continuous engineering observation and in accordance with the following:

- Demolition and removal of all abandoned, hidden, or buried improvements including foundations, slabs, pipes, tanks, cables, or leach-line on-site wastewater disposal systems from structural fill areas. AGI is not aware of any on-site water wells in the project. If a well is discovered, it should be properly sealed and capped by a licensed drilling contractor in accordance with Los Angeles County regulations. The geotechnical engineer must receive a copy of the well closure report. The engineer or his representatives should perform observations of all site demolition work on an as-needed basis to document the nature and depths of buried improvements as they are removed.

- Clearing and grubbing of grasses, shrubs, trees, and all major roots should be completed as determined by site conditions.

- Excavation of undocumented fill, disturbed or porous sediments, or other unsuitable material as determined by the geotechnical engineer shall be performed in accordance with an approved soils investigation report. Excavation bottoms in the WCA project site could variously consist of dense native older alluvium or bedrock.

- Observation and acceptance of all stripped areas should be made by the qualified professional engineer and/or engineering geologist and/or their designated representative prior to placing fill.

- Scarification of exposed bottoms to specified depths, moisture-conditioning by adding moisture or drying back to specified water contents, and proof-rolling with heavy rubber-tire equipment (earthmoving scrapers, large loaders, or similar) for initial compaction and to detect soft zones prior to fill placement.

- Fill soils should be uniformly moisture-conditioned by mixing and blending, and placed in lifts having thicknesses commensurate with the type of compaction equipment used, but generally no greater than 6 to 8 inches. At the present time, AGI believes all site soils within the project should be suitable for reuse in compacted fills. Wood, roots, and inorganic debris (if present) will need to be picked from surficial soils and removed from the site.

- Rocks or other similar irreducible inert matter larger than about 6 inches in diameter would not normally be allowed in unrestricted engineered compacted fills. We would not anticipate needs for oversize materials disposal.

- Continuous engineering field observation and testing should be expected for verification that specified minimum compaction and soil water contents are being uniformly achieved. Field density tests will be performed in accordance with the approved investigation report and Los Angeles County codes.

6.3 Preliminary Slope Design Criteria

It is not known if site programming concepts will include manufactured cut or fill slopes. AGI advises that graded slopes at the site (other than beside foot trails) generally be designed and built in accordance with the following:

- All fill slopes should be constructed at maximum slope inclinations of 2:1 (horizontal:vertical).
- Cut slopes in the native older fan sediments should be excavated and reconstructed as stabilization fill slopes, if 5 feet or greater in height.
- The surfaces of all fill slopes should be compacted to where they equal or exceed minimum compaction for mass fill, and should be free of slough or loose soils.
- Findings from this study indicate bedrock slopes in volcanic bedrock may be feasible and stable at inclinations of up 1:1. Slope-specific geological evaluations would be recommended to verify this preliminary opinion.

- The ground surface adjacent to the tops of slopes should designed and graded to drain water away from the slopes. Brow ditches will be required for new cut slopes intercepting ascending ground above the cut.
- Erosion control measures will need to be implemented for all slopes as soon as practicable after slope completion, per applicable County ordinances.

6.4 2010 California Building Code Seismic Design Criteria

Prescriptive mitigation for the hazard of strong ground motion is nominally provided by structural design adherence to local adopted building codes. The governing 2010 California Building Code (CBC, based on the 2009 *International Building Code*) adopts the seismic loads calculated from the 2008 probabilistic National seismic hazard model. The latter in turn implicitly incorporates near-source strong-motion risks in the mapped point data. Soil correction factors account for amplification of lower-amplitude strong motion at soft-soil sites. Like the previous 2007 CBC and older codes based on the *Uniform Building Code*, design coefficients are still ultimately functions of distance to active faults, fault activity, and measured or correlated mean shear wave velocity within 30 meters (~100 feet) of the ground surface.

The following tabulated criteria were derived in accordance with the rules of Section 1613 of the 2010 CBC and ASCE Standard 7-05. These criteria are conservative assumptions for existing or future buildings founded atop deep unit "Qofs" older fan sediments. Stakeholders should understand that rock sites and localities underlain by thin alluvial deposits, including most or all historical structures in the WCA project, may have stiffer (more-favorable) soil profiles. Subsurface drilling would be needed to verify final spectral acceleration values. Nevertheless, the "worst-case" values presented may be useful in calculating feasibility and costs of structural upgrades to the buildings.

Table 6.4-1
Example 2010 CBC Seismic Design Factors and Coefficients
(Lat. 34.089, Long. 117.828)
"Deep-Soil Condition"

2010 CBC Section #	Seismic Parameter	Indicated Value or Classification
1613.5.1	Mapped Acceleration S_s	2.003g (Note 1)
	Mapped Acceleration S_1	0.710g (Note 1)
1613.5.2	Site Class	D (Note 2)
1613.5.3(1)	Site Coefficient F_a	1.0
1613.5.3(2)	Site Coefficient F_v	1.5
1613.5.3	Adjusted MCE Spectral Response S_{MS}	2.003g
	Adjusted MCE Spectral Response S_{M1}	1.076g
1613.5.4	Design Spectral Response S_{DS}	1.335g (Note 4)
	Design Spectral Response S_{D1}	0.710g (Note 4)

(1) Interpolated from 0.01-degree gridded data in the probabilistic 2008 National Seismic Hazard Model (U.S. Geol. Survey, 2011b), 2% in 50-year exceedance probability.
(2) Based on corrected SPT blow counts in sediments where 15≤N≤50 and assumed depth to less-weathered crystalline rock exceeds 100 feet.
(3) Defined by 2010 CBC §1613.1 and the statement of ASCE 7-05 §21.2.3 indicating site-specific MCE response spectral acceleration at any period shall be taken as the lesser of the probabilistic or deterministic spectral response accelerations (latter subject to lower-limit rules). The design spectral response accelerations are calculated as ⅔ of the MCE value.

It should be understood that the 2010 CBC defines minimum criteria needed to produce acceptable life-safety performance. Code-compliant buildings can still suffer damage or loss. Project owners should be aware that structures can be designed to further limit earthquake damage, sometimes for modest cost premiums. Ultimately, final selection of design coefficients should be made by the structural consultant based on local guidelines and ordinances, expected building response, and the owner's desired performance objectives.

6.5 Water Quality Management Plan

It is assumed that almost any development plan will create needs for stormwater management and control of site runoff. The following bulleted points represent AGI's early opinions regarding prudent engineering practice and site characteristics pertinent to BMP selection. Data needed to gain approval of water quality management plans and site BMPs must be based on in-situ infiltration tests.

- Uncontrolled runoff over the mesa slopes in the western half of the project area should be avoided. Two deep gullies have already been notched into the brow in the extreme northwestern part of the site. Surface runoff near the brow should be conveyed downslope to ravine bottoms in non-erosive swales, culverts, or buried pipes. A bioswale might also be an effective interceptor.
- Areas underlain by unit Qofs are probably suitable for infiltration-type BMPs. The soils appear to be permeable and lack shallow hardpans. Basins, swales, infiltration chambers, permeable pavements, or other absorption systems should be feasible.
- Areas underlain by unit Tga, volcanic bedrock, are preliminarily considered *not suitable* for infiltration-type BMPs.
- Infiltration basins are not recommended upslope from unit Tpl (La Vida siltstone) in the northwestern corner of the project. It is probably best from a slope stability perspective to rapidly remove local runoff from this area via a non-erosive conduit to canyon or ravine bottoms.

6.6 Wastewater Disposal

AGI was not made aware of the condition or termination point of existing sanitary sewers in the WCA historical building area. We have assumed they may end in the Tzu Chi property. New connections to San Dimas mains, or a private on-site disposal system have been considered for this feasibility study.

Gravity and/or pumped force main connections to Woodwalk tract mains may be feasible through the Calle Bandera access, or possibly through Loma Vista Park. We think trenches in the area would encounter mostly easy-to-excavate alluvial soils. Both Calle Bandera and the city park are considerably higher in elevation than some buildings such as the old Voorhis maintenance structure, so a pumped system could be the only option.

AGI also judges an OWTS to be feasible if municipal sewer service is unavailable. Sewage disposal is regulated by the County and by the Santa Ana Regional Water Quality Control Board. The WCA project meets one basic Regional Board requirement: The parcel must be at least 0.5 acres in size. Conventional septic tank and effluent disposal options such as absorption fields or seepage pits would appear to be allowable under current County rules. More-modern "alternative" systems could be required, however. Alternative systems are pre-engineered package treatment plants meeting certain class criteria for nutrient removal and bacteriological safety. They have fairly strict requirements for monitoring (commonly real-time Internet based), maintenance, and (possibly) annual licensing. Other rules applicable to conventional systems are relaxed, however, including allowable uphill pumped effluent disposal and the creation of absorption fields in man-made fill. Effluent disposal is accomplished through a shallow pressurized dispersal system consisting of easily installed small pipes (perforated or with turbulent drip-type emitters) buried at depths of a foot or less. Alternative OWTS's are generally specified with the help of the manufacturer's regional representatives and their licensed contractors.

6.7 Further Recommended Investigation

Future subsurface studies are recommended to define remedial earthwork limits and depths, and provide preliminary design parameters for new foundations, walls, pavements, and buried utility lines. Soil borings or test pits should be expected. The scope of the geotechnical investigation should be tailored to the actual locations and types of proposed construction. Subsurface exploration and testing is also a mandatory need for design of treatment-type best management practices (BMPs) that may be specified for runoff water quality management.

6.8 Feasibility Investigation Limitations

The present findings and opinions are based on the results of cursory field reconnaissance and the anticipated nature of park site improvements. The nature and extent of variations from observed conditions, particularly at depth, may not become evident until subsurface work is completed. This study is a guideline document for planning purposes. It is not intended for construction. Many areas or features could be deemed unsuitable or require greater engineered mitigation than currently assumed.

7.0 CLOSURE

This report was prepared for the use of AHBE Landscape Architects and their designates, in cooperation with this office. All professional services provided in connection with the preceding report were prepared in accordance with generally accepted professional engineering principles and local practice in the fields of soil mechanics, foundation engineering, and engineering geology for feasibility-level surveys. We make no other warranty, either expressed or implied.

We have enjoyed assisting in the site programming studies for this project. If you should have any questions, please contact either of the undersigned at our Riverside office at (951) 776-0345.

Respectfully submitted,
Aragón Geotechnical, Inc.

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MGD/CFA:mma

Attachments: Plate Nos. 1 & 2 (in pocket)

Distribution: (4) Addressee

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AERIAL PHOTOGRAPHS

Voorhis Collection, Cal Poly Pomona University Library

Date Flown	Flight Number	Scale	Frame Numbers
Various	n/a	Various	Several aerial oblique images taken 1930(?)-1936, encompassing the Voorhis property and surrounding hills.
5-27-38	AXJ-34	est. 1:24,000	Nos. 102-103
1968	AAS #600	est. 1:12,000	Nos. 001-003